PEACE/WILLISTON
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COMPENSATION
PROGRAM

BC hydro

BRITISH COLUMBIA

Fish Stocking Assessment Of Little Carbon Lake, 1998

R. J. Zemlak
May 1999

PWFWCP Report No. 200

The Peace/Williston Fish & Wildlife Compensation Program is a cooperative venture of BC Hydro and the provincial fish and wildlife management agencies, supported by funding from BC Hydro. The Program was established to enhance and protect fish and wildlife resources affected by the construction of the W.A.C. Bennett and Peace Canyon dams on the Peace River, and the subsequent creation of the Williston and Dinosaur Reservoirs.

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Website: *www.bchydro.bc.ca/environment/initiatives/pwcp/*

This report has been approved by the Peace/Williston Fish and Wildlife Compensation Program Fish Technical Committee.

Citation: R. J. Zemlak. May 1999. Fish stocking assessment of Little Carbon Lake, 1998. Peace/Williston Fish and Wildlife Compensation Program, Report No. 200. 13pp plus appendices.

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LITTLE CARBON LAKE

WATERSHED: Peace River

DATE OF SURVEY: September 22. 1998

FIELD CREW LEADER: Randy J. Zemlak

FIELD ASSISSTANT: Arne R. Langston

PEACE/WILLISTON FISH AND WILDLIFE COMPENSATION PROGRAM

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FISH AND WILDLIFE BRANCH

REPORT PREPARED BY: RANDY J. ZEMLAK

105-02343/

INTRODUCTION

Little Carbon Lake is a remote sub-alpine lake located near Hudson's Hope BC (Figure 1). The lake has received some attention over the past 8 years from fish biologists with both the Ministry of Environment, Lands and Parks (MELP) and the Peace/Williston Fish and Wildlife Compensation Program (PWFWCP). In the early 1990's, Little Carbon Lake was thought to be a barren lake of all fish species and could be a suitable candidate for a salmonid stocking program. Therefore, the first survey deemed necessary was to conduct and find out if the winter oxygen levels would be adequate enough to support salmonids over the winter. During the winter of 1991, a winter oxygen/temperature profile was taken on Little Carbon Lake. Results of this survey proved that the lake could support fish over the winter. The next survey on the lake took place later on that summer to find out if the lake was actually barren and could support a fish population. In July 1991, a reconnaissance level survey was conducted on Little Carbon Lake by the PWFWCP. The survey results indicated that the lake was indeed barren and could support a future fish-stocking program. This initial reconnaissance level survey report can be viewed at the PWFWCP office (address on cover page).

In 1993, Little Carbon Lake was initially stocked with 500 rainbow trout. The lake has then been stocked for another three consecutive years. No previous surveys or stocking assessments have been conducted on Little Carbon Lake since that time. Therefore, in 1998, Little Carbon Lake was targeted as a high priority for a fish stocking evaluation as part of the stock assessment program for the Peace Region. During September 1998, PWFWCP fish biologists investigated Little Carbon Lake primarily to evaluate the success of the current fish-stocking program.

LAKE LOCATION

Location:	41 km west/southwest of Hudson's Hope BC
Elevation:	± 1,387 m
Latitude/Longitude:	55° 58' 46" : 122° 35' 44"
U.T.M.:	10.525031.6203844 (NAD 1983)
Management Unit:	7-31
N.T.S. Map No.:	93 - O/15
Waterbody Identifier:	00219PCEA
Lake Drainage:	UnnamedCr.—>CarbonCr.—>WillistonReservoir (PeaceReach)—>PeaceR.

Figure 1. Location of Little Carbon Lake. Scale 1:50,000

ACCESS

Road access to Little Carbon Lake does not exist. There are only two ways to reach this lake: by foot from Carbon Lake or by helicopter. Access to the lake for this field survey was achieved by first driving to the Carbon Lake Lodge (km 64 of the Johnson Creek Forest Service Road) and then taking a helicopter from the lodge to transport staff and equipment into Little Carbon Lake (5 minute helicopter ride).

Road access directions start from Hudson's Hope and go as far as the lodge on Carbon Lake. From the town of Hudson's Hope, travel northwest to the WAC Bennett Dam. Cross the dam and keep right at the hairpin corner. The surface of the road changes from pavement to gravel. This gravel road is called the "Utah East" Road. Travel 6.3 km until a three-way intersection is reached. The Utah Road ends. Stay left at the intersection on the "Table Creek" Road. Travel another 2.3 km until another three-way intersection is reached. The Table Creek Road ends. At the intersection, stay on the right fork (km 45 of the Johnson Creek Forest Service Road). Taking the right fork will take you to the Carbon Lake Lodge (located at km 64). From the fork, travel another 19 km to the lodge. From the lodge entrance, a helicopter was used to gain access to Little Carbon Lake.

Alternately, foot access to Little Carbon Lake can be obtained from either of two places. First, from the Carbon Lake Lodge, travel across the lake to the west shore. From here, there is an old game trail that people have used in the past to hike up the hill to Little Carbon Lake. This hike will take approximately two hours. Secondly, another hiking trail exists off of the Johnson Creek Forest Service Road, before you reach Carbon Lake. Between km 59 and 60, there is a small pull out on the right side of the road-heading west. At this point, a small sign is present indicating the length and level of difficulty of the hiking trail to Little Carbon Lake.

STOCKING HISTORY

Rainbow Trout

Little Carbon Lake was initially stocked with 500 rainbow trout in 1993 (Table 1) and continued annually until 1996. In 1997, the stocking of Little Carbon Lake ceased and has not been stocked since that time. A request was submitted in December 1997 to stock the lake in 1998 (but never happened) and every second year thereafter. Many different types of stocks have been introduced. Of these different strains, approximately 2,000 rainbow trout have been stocked into Little Carbon Lake during a four-year period. The life

stage of all of these stocked fish has been yearlings. The average size of these rainbow trout has been 5.9 g.

Table 1. Little Carbon Lake rainbow trout stocking history.

Year	Number	Size (g)	Life Stage	Stock
1993	500	3.7	Yearling	Dragon/Tunkwa
1994	500	7.5	Yearling	Tunkwa
1995	500	7.8	Yearling	Tunkwa
1996	500	4.6	Yearling	Beaver

METHODS

Little Carbon Lake's rainbow trout stocking program was assessed in September of 1998 by fish biologists from the PWFWCP. Three different techniques were used to determine the relative abundance of fish species in Little Carbon Lake: gill nets, Gee traps, and angling gear. Conversations with fish biologist from MELP in Fort St. John prior to the fieldwork suggested that a one-day netting effort should capture enough fish to indicate if a sport fishery has been created in Little Carbon Lake. Therefore, no gill net sets were required to set overnight in the lake. One sinking monofilament experimental gill net was used. The net consisted of six different sized mesh panels ranging from 25 to 85 mm. Each panel is 15.24 m long and 2.4 m wide. The gill net effort was set along the west shore by the outlet. The second method used to capture fish was Gee traps. Each Gee trap (two in total) was baited with sardines and set during the day. The Gee traps were set in shallow (< 2 m) littoral habitat near the shoreline. The third technique used to capture fish was angling gear. A spin cast rod with an assortment of lures and a fly rod with dry flies was utilized.

The rainbow trout captured in the gill net were measured for fork length and weight. Any fish still alive in the net was released after sampling of the fish. A biological examination of the dead fish captured in the net was conducted which revealed it's sex, sexual maturity, stomach contents, and disease/parasite presence or absence. Scale samples for all fish (dead or alive) were collected for age determination and analysis was performed by North/South Consultants from Winnipeg, Manitoba. General appearance of the fish was determined through visual analysis. Mean lengths and weights were determined for each age class of rainbow trout. Condition factors (Weight/ $Length^3$ x 100) were determined for each individual fish.

Fish captured by means other than a gill net were sampled less intensively. All fish captured in the Gee traps were to be measured for fork length and

then released alive. Any fish captured by angling gear were only sampled for fork length and weight. A scale sample was also taken for age determination. Then, the fish was released alive (no determination of sex or stomach content was performed). The mean lengths and weights and condition factors were also calculated for these live captured fish.

The habitat features of Little Carbon Lake were briefly assessed and documented. The entire perimeter of the lake was observed for any new possible inlets not identified in the original reconnaissance level survey. The outlet stream was briefly assessed for salmonid spawning potential. In addition, photo documentation of some of the habitat features of Little Carbon Lake was taken. The benchmark established during the original study (1991) was located. Changes to the current water level was measured with an Abney level, 1.5 m staff, and a 30 m Eslon tape. Reference to the high water mark was also measured and recorded. Any new developments constructed after the original survey in 1991 were also recorded.

RESULTS

Gill Nets

One gill net was set during in the morning of September 22 on the west shore (Figure 2). The net was checked regularly and any captured fish that were still alive were sampled immediately. The net was pulled later on in the afternoon. This net yielded only one fish species, which was rainbow trout. The gill net, set for 4.6 hours (Appendix 1), produced a total of 16 rainbow trout (RB), (Table 2). Only four of the 16 rainbow trout captured in the gill net died.

Table 2. Gill net catch summary for Little Carbon Lake, 1998.

Date	Species	Net Site		Total	Number Sampled	Number Preserved	Size Range (cm)
		1	2				
Sept. 22	RB	16	0	16	16	0	21.6 - 37.6

Gee Traps

Two Gee traps were used to capture juvenile fish. The traps were also set in the morning and pulled in the afternoon (Figure 2) for a minimum of 6 hours (Table 3). No fish were captured in either of the Gee traps.

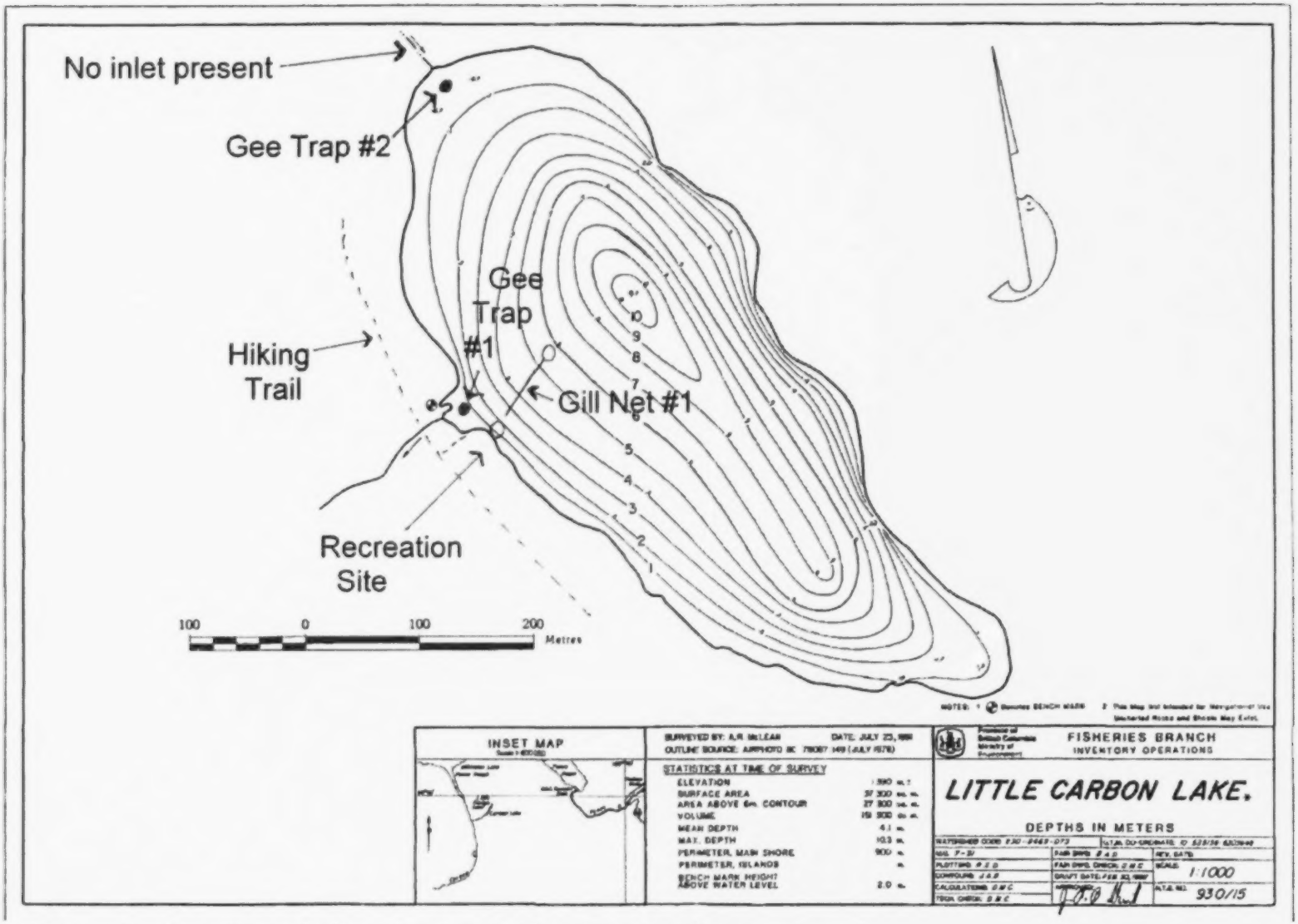

Figure 2. Location of gill net set and Gee trap locations.

Table 3. Gee trap results.

Trap #	Hours fished	Depth (m)	Substrate	Species	Number	Size Range (mm)
1	6.0	0.5	organics on boulder	none	0	n/a
2	6.0	0.3	organics	none	0	n/a

Angling

Angling by program staff proved to be an effective method of capturing rainbow trout. On September 22, two program staff fished for 3.0 hours and captured 19 rainbow trout. Catch per unit effort is 3.2 fish per rod hour. Only a measure of fork length and weight and a scale was collected for each of these captured fish.

Angling captured most of the rainbow trout sampled during this survey. Age determination for all captured rainbow trout (n = 35) was determined by a consultant (Appendix 2). Prints of the scales and age markings were provided for each fish, and reviewed by PWFWCP fish biologists. No obvious errors were detected, although six samples were of poor quality and difficult to age. Mean fork lengths and weights (Table 4) were calculated for all rainbow trout. The average condition factor for the 35 captured rainbow trout is 0.9639. In addition, 3 charts (length versus weight, age versus length, and length frequency distribution) were created to observe the population dynamics of these fish and were used to understand their growth and condition (Figures 3 to 5).

Table 4. Population characteristics of rainbow trout in Little Carbon Lake, 1998.

Age Class	Sample No.	Mean Length (cm)	Range of Length (cm)	SD for Length	Mean Weight (g)	Range of Weight (g)	SD for Weight
2	11	23.3	21.6 - 25.5	1.28	127.2	96.8 - 160.6	20.5
3	13	28.3	24.8 - 32.3	2.47	222.2	160.1 - 297.5	48.2
4	8	33.2	29.1 - 38.6	3.46	327.8	235.5 - 472.5	80.4
5	3	32.6	32.1 - 33.0	0.47	339.1	307.9 - 388.5	43.3

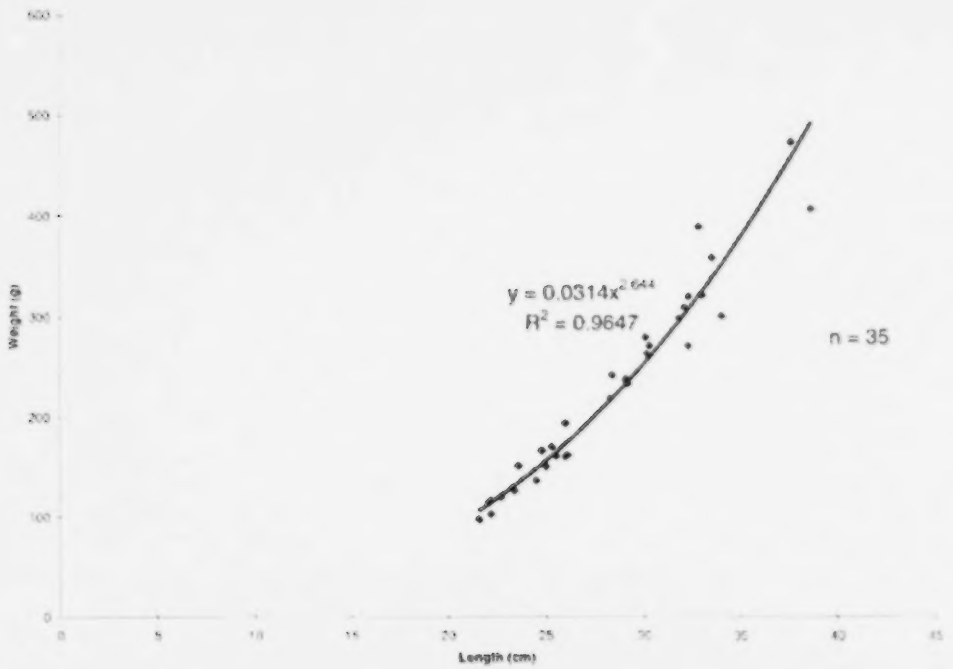

Figure 3. Length versus weight of rainbow trout in Little Carbon Lake, 1998.

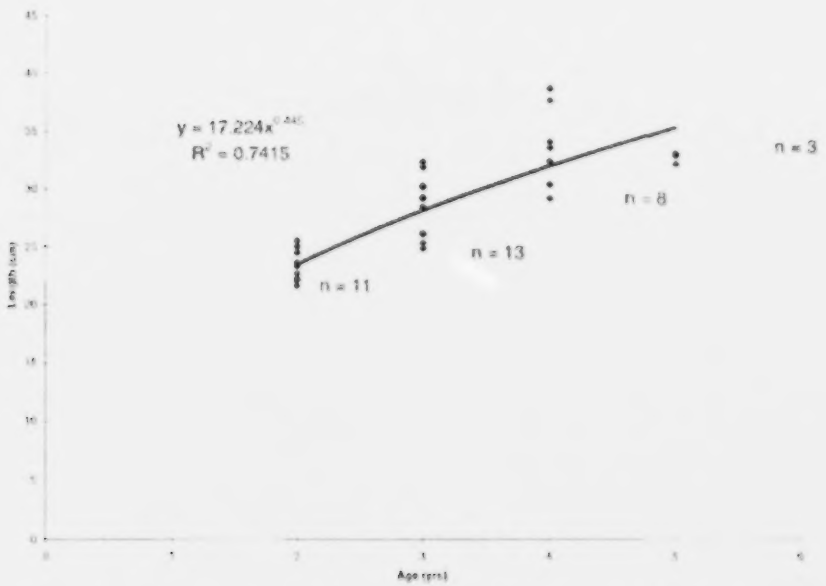

Figure 4. Age versus length of rainbow trout in Little Carbon Lake, 1998.

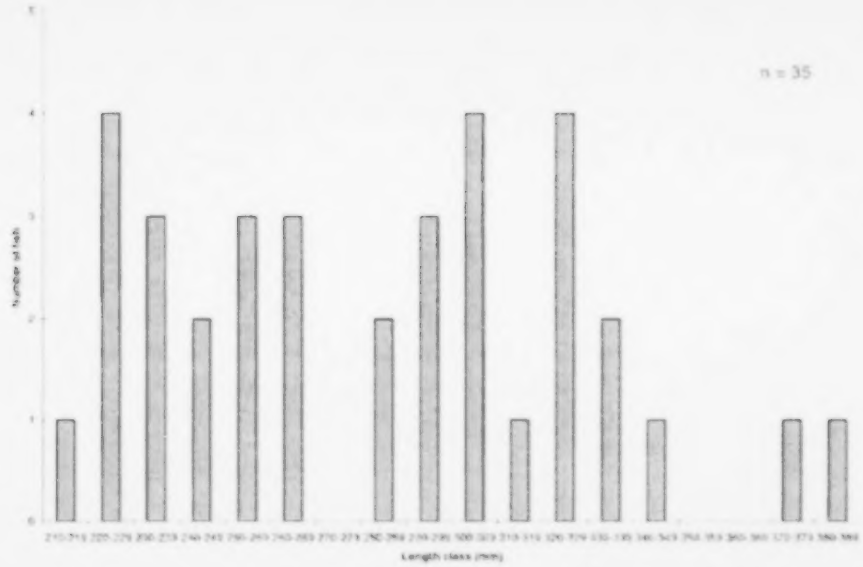

Figure 5. Length frequency distribution of rainbow trout in Little Carbon Lake, 1998.

BIOLOGICAL ANALYSIS OF RAINBOW AND BULL TROUT

A biological analysis was conducted on 4 of the 35 captured rainbow trout (Appendix 2). Since the majority of the fish captured were alive (n = 31), there was no need to kill them to sample them from a biological standpoint. Of the four dead fish, three were females and one was a male. Reproductive organ analysis revealed that two fish were maturing, one fish was mature, and one fish was gravid (spawnbound). Examination of stomach contents revealed that the captured fish were keying in on shrimp and insects as their main food source (dragon flies, water boatman, beetles, and ants) at the time of this survey. All four fish had full stomachs. External examination indicated healthy fish while internal examination also revealed apparently healthy fish as no obvious tapeworms or other parasites were observed in the body cavity.

DRAINAGE AND HABITAT FEATURES

Little Carbon Lake currently has no inlets and one outlet. The reconnaissance level survey conducted in 1991 indicated that there was an intermittent inlet located on the north shore. The survey conducted in 1998 revealed that this

inlet does not exist and that there was no evidence of an old dry creek channel. The outlet drains west and flows approximately 5 km southwest to its confluence with Carbon Creek. At the time of the 1998 survey, this outlet was dry and there was no sign of subterranean flow. The initial part of the outlet contained no salmonid spawning substrate and would not be of much value to the rainbow trout even if there were flow. A series of falls and cascades are present in the outlet (starting 70 m downstream of the lake). The water level in Little Carbon Lake is not controlled by any beaver dams. The high water mark was difficult to detect and was estimated at 20 cm.

BENCHMARK

The benchmark, located on the west shore, was re-located by PWFWCP fish biologists during the 1998 survey (Figure 2). A.R. McLean originally set this benchmark in 1991, 2.0 m above the lake water level. The iron spike was said to be located in a 30 cm diameter spruce tree, 4.0 m from the water's edge. During the 1998 survey, field staff had located the benchmark, but it was in a different species of tree. It was located in a 30 cm D.B.H. lodgepole pine tree, 5.5 m from the water's edge. The benchmark was re-painted orange (Plate 1). In 1998, the benchmark was at 2.06 m above current lake level, indicating a 0.06 m drop in water level from 1991. The benchmark is roughly 40 m north of the small recreation campsite located on the west shore (Plate 2).

FISHERIES MANAGEMENT COMMENTS

Little Carbon Lake supports a population of stocked rainbow trout. No other stock assessments have been conducted on Little Carbon Lake to compare the rainbow trout net catch per unit effort. In 1998, the net yielded 16 rainbow trout for a catch per unit effort of approximately 3.5 rainbow trout per net-hour. The net was set for a short time (4.6 hours) during the day. An overnight net set may have produced more rainbow trout to better understand the population dynamics but would have unnecessarily killed them.

Angling efforts produced a similar catch per unit effort as compared to the gill net. About 54 % of the captured fish during the 1998 survey were obtained through angling. Two people fished for 3.0 hours and captured 19 rainbow trout for a catch per unit effort of 3.2 fish per hour. These fish were only sampled for lengths and weights and a scale sample was taken for age determination. All angled fish were then released alive.

Plate 1: Photo of the benchmark located on the west shore (just north of the outlet).

Plate 2: Photo of the user maintained campsite (west shore), 20 m south of the outlet.

The length versus weight relationship of rainbow trout shows the population of fish sampled is not very rotund (Figure 3). The weight of these fish increase according to the equation $W = 0.0314 \times L^{2.644}$. With the exponent value being *less than* 3, this would indicate the population is not very chubby and have the ability to grow larger.

The growth of the rainbow trout population (Figure 4) appears to be somewhat slow for the older fish (age 5). In the second to fourth years, the rainbow trout population appears to distribute adequate growth. At age two, the mean length was 23.3 cm. The age three fish show a mean length of 28.3 cm. At age four, the average length only increased to 33.2 cm, and at age 5, the average length was less at 32.6 cm. This smaller size of age 5 fish is due to the small sample size captured, not because they are shrinking. Food resources for these larger rainbow trout could be somewhat limited in Little Carbon Lake.

The length frequency distribution of rainbow trout shows a fairly even distribution of fish from lengths 220 to 320 mm (Figure 5). No age 1 fish were captured which corresponds to the stocking history and the fact that there appears to be no suitable spawning habitat for these fish to reproduce. The longest fish captured was 386 mm.

Natural recruitment to re-populate rainbow trout in Little Carbon Lake is not currently available. There are no inlet streams, which contribute to any spawning habitat. The outlet, which possesses mainly larger sized substrate (over 100 mm) was not flowing at the time of this survey. Water levels in the outlet appear to vary each year based on the newly growing vegetation in the stream channel when there is currently no flow. At this point in time, a periodic stocking program would appear to be more desirable than trying to enhance the habitat in the outlet for rainbow trout spawning.

Angling pressure on this lake for rainbow trout is present, but the exact amount of use and their catch is unknown. During this survey, eight fish heads were observed in the water near the shoreline by the campsite area indicating some people were recently fishing in Little Carbon Lake. Also, it is unknown if any people fish this lake during the winter. Future surveys would help define the angling pressure, but probably is not warranted.

MISCELLANEOUS COMMENTS

1. A recreation site is developed on the west shore. No picnic tables are present, two fire pits are here, and no outhouses have been constructed. This is a user-maintained site.

2. A hiking trail is present along the west shore. This trail originates from the north shore of Carbon Lake. The trail meanders uphill to Little Carbon Lake and then continues north to Battleship Mountain. The trail is marked with small orange markers.

FISH STOCKING PROGRAM

The stocking of Little Carbon Lake with rainbow trout appears to be successful as a sport fishery has been created. There does not appear to be any accessible spawning habitat available for rainbow trout in Little Carbon Lake. However, fish could eventually have access downstream of the outlet and populate Carbon Creek during high flows. Fish trying to migrate back into Little Carbon Lake experience difficulty as there are cascades and falls present. It would probably be more desirable to continue stocking with a sterile fish as there is no spawning habitat available for the fish in Little Carbon Lake. Currently the stocking has ceased over the last two years. Since the rainbow trout captured in 1998 are not too robust, the stocking of fish every third year would allow these fish some time to grow and get larger. In addition, it would be less expensive than stocking every year. The number of fish should increase to 2,000 fish as oppose to the current number of 500.

In summary, the stocking of Little Carbon Lake should change to a) a sterile strain, b) increase the rate to 2,000, and c) stock every three years. This new stocking strategy should allow for the fish to grow slightly larger and reduce the costs over time. It is recommended that Little Carbon Lake should be stocked in the summer of 2000 and 2003. The lake should then be assessed again in the year 2005 (after two complete stocking efforts) to see if this new strategy has slightly increased the size of fish while still maintaining a sport fishery in Little Carbon Lake.

LITERATURE CITED

McLean, A.R. 1991. Data sheets on winter oxygen/temperature profile for Little Carbon Lake. Taken on March 18, 1991 by the Peace/Williston Fish and Wildlife Compensation Program.

McLean, A.R. 1991. A reconnaissance survey of Little Carbon Lake. Peace/Williston Fish and Wildlife Compensation Program Report No. 108. 20pp plus appendicies.

APPENDIX 1

Netting Record

NETTING RECORD

Mesh sizes experimental order: 25, 76, 51, 89, 38, 64 mm

NETTING SITE #1

Type:	Sinking monofilament gill net		
Date Set:	September 22, 1998	Time:	1000 hrs
Date Lifted:	September 22, 1998	Time:	1437 hrs
Net Dimensions:	Length: 91.4 m	Depth:	2.4 m
Shallow End Mesh Size:	25 mm	Depth: Substrate:	0.75 m boulder/cobble
Deep End Mesh Size:	64 mm	Depth: Substrate:	8.5 m organics

Comments:

Set in the same location as the 1991 survey. Net was checked at 1212 on September 22. The net had 3 dead and 8 alive rainbow trout at the time. The fish were pulled out and sampled. The net was kept in the water to fish longer. The net was pulled on the same day and the net catch yielded a total of 16 rainbow trout for the 4.6 hours it fished.

APPENDIX 2

Individual Fish Data

Lake: **Little Carbon**

INDIVIDUAL FISH DATA

Date Captured: September 22, 1998
Angling and Gill Net #1

M - Male
F - Female
? - Not Obvious

IMM - Immature
MG - Maturing
MT - Mature
GV - Gravid
SP - Spent
? - Not Obvious

EG - Egg
ML - Milt
HD - Head
TG - Fish Tag
ST - Stomach

SC - Scale
FR - Fin Ray
OT - Otolith
WF - Whole Fish

Method of Capture: Sinking monofilament gill net.
Condition Factor (K) = $W / L^3 \times 100$

Species	Fork Length (cm)	Weight (grains)	K	Gonadal Maturity	Sex	Age (yrs)	Stomach Contents					Comments
							Bottom Organisms	Plankton	Insects	Fish	Other	
RB	23.3	128.5	1.0159			2						released alive
RB	22.2	102.2	0.9341			2						released alive
RB	22.2	115.5	1.0557			2						released alive
RB	22.7	119.4	1.0208			2						released alive
RB	29.2	233.1	0.9363			3						released alive
RB	34.0	300.2	0.7638			4						emaciated
RB	21.6	96.8	0.9605			2						released alive
RB	24.5	136.1	0.9255			2						released alive
RB	22.1	113.9	1.0552			2						released alive
RB	25.3	169.5	1.0467			3						released alive
RB	25.0	150.0	0.9600			2						released alive
RB	29.1	237.5	0.9638			3						released alive
RB	24.8	165.9	1.0877			3						released alive
RB	37.6	472.5	0.8889			4						released alive

Lake: **Little Carbon**

RB	26.0	193.3	1.0998	GV	F	3			boatman		clam	**dragon fly**
RB	23.6	150.6	1.1457	MT	M	2			shrimp		ant	**dragon fly**
RB	28.3	217.7	0.9605	MG	F	3			shrimp		organics	**? insect**
RB	25.5	160.6	0.9686			2						**released alive**
RB	30.3	270.3	0.9717			4						**released alive**
RB	28.4	241.2	1.0530			3						**released alive**
RB	23.4	125.6	0.9803			2						**released alive**
RB	26.1	161.3	0.9072			3						**released alive**

Lake: **Little Carbon**

INDIVIDUAL FISH DATA

Date Captured: September 22, 1998
Angling and Gill Net #1

M - Male
F - Female
? - Not Obvious

IMM - Immature
MG - Maturing
MT - Mature
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SP - Spent
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EG - Egg
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FR - Fin Ray
OT - Otolith
WF - Whole Fish

Method of Capture: Sinking monofilament gill net.
Condition Factor (K) = $W / L^3 \times 100$

Species	Fork Length (cm)	Weight (grams)	K	Gonadal Maturity	Sex	Age (yrs)	Stomach Contents					Comments
							Bottom Organisms	Plankton	Insects	Fish	Other	
RB	32.1	307.9	0.93O9	MG	F	5	detritus		boatman			beetles
RB	38.6	406.4	0.7066			4						released alive
RB	31.8	297.5	0.9251			3						released alive
RB	32.3	319.0	0.9466			4						released alive
RB	26.0	160.1	0.9109			3						released alive
RB	30.1	278.8	1.0223			3						released alive
RB	32.8	388.5	1.1010			5						released alive
RB	30.2	262.2	0.9519			3						released alive
RB	32.3	270.2	0.8018			3						released alive
RB	3O.3	260.4	0.9361			4						released alive
RB	29.1	235.5	0.9557			4						released alive
RB	33.0	321.0	0.8932			5						released alive
RB	33.5	358.0	0.9522			4						released alive

- Of the 35 rainbow trout sampled, 19 fish were angled and 16 were captured in the gill net.
- The average condition factor for all 35 rainbow trout is 0.9639.

AGE DETERMINATION COMPLETED BY:

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